

Soil Guideline Values

Frequently Asked Questions

April 2011

This document is a summary of frequently asked questions concerning Soil Guideline Values (SGV), supporting technical guidance, and the CLEA software.

Questions and Answers

Why has the 'bioaccessible fraction' changed to 'relative bioavailability' in the CLEA software v1.05?

In CLEA version 1.05, we have replaced the bioaccessibility factor with the relative bioavailability factor and the description in the software and handbook amended accordingly. While the descriptive text has been amended, the way that the model applies this factor has not changed from the previous version (that is, version 1.04).

Bioaccessibility and relative bioavailability are terms that have been commonly used interchangeably. In general this is incorrect as the two terms do not share the same definition. However, in the particular case of arsenic the mathematical relationship between the two parameters can be simplified to demonstrate that they are approximately equivalent.

Why can't I use the CLEA software v1.06 to derive soil assessment criteria for dioxins?

The toxicity of compounds showing dioxin-like modes of action is considered additive. The CLEA software does not account for additivity between chemicals and therefore cannot be used directly for calculating soil assessment criteria for dioxins, furans and dioxin-like PCBs.

We have made available on our web site, dioxins site-specific spreadsheets that you can use, in conjunction with Science Report SC050021/ Dioxins SGV 'Soil Guideline Values for dioxins, furans and dioxin-like PCBs in soil' to derive assessment criteria.

To use the worksheets you enter soil concentration data for all 29 congeners. For non-standard land uses, you are required to enter exposure factor data derived using the CLEA software v1.06. Science Report SC050021 / Dioxins SGV explains how to use these worksheets.

Why does the CLEA software v1.06 not include all the chemical data contained within Science Report SC050021/SR7 'Compilation of chemical data for the derivation of Soil Guideline Values'?

We have only added chemical data into the chemical library of the CLEA software v1.06 when complete datasets are available. For some chemicals we have not completed our toxicological review or our review of other relevant data such as plant uptake data or soil to dust concentration factors. If we were to add partial datasets to the chemical library you would have to add the missing data in the advanced setting section of the software before you could derive soil assessment criteria. To avoid confusion as to which datasets may or may not be complete we have only added data when we have a complete data set.

Why is the cadmium SGV for allotments lower than the provisional limit for applying sewage sludge to land?

The cadmium Soil Guideline Value (SGV) for the allotment land-use scenario is lower than the provisional cadmium limit for applying sewage sludge to agricultural soils of $3 \text{ mg kg}^{-1} \text{ DW}$ set out in The Sludge (Use in Agriculture) Regulations 1989 (TSO, 1989; DoE, 1995).

The Sludge Regulations apply to the protection of soil fertility from the use of sewage sludge in agriculture and are used in conjunction with a code of practice for the use of sludge and other management guidelines (DoE, 1995; ADAS, 2001). Although the sludge application limit for cadmium is intended to restrict entry of cadmium into the human and animal food chains via crops, it is very difficult to compare health protection objectives directly with the SGV. However, it is useful to note that:

SGV relate to multiple sources and forms of cadmium contamination and not only those from a single source such as sewage sludge; allotment holders are not subject to management guidelines or a code of practice, and therefore overall practice is less controlled; and allotment holders in the land use scenario are assumed to consume a greater proportion of their fruit and vegetables from the same source (i.e. the same plot) and their exposure will be much more sensitive to soil concentration;

SGV have been based on the most recent expert opinion on the toxicology of cadmium.

Further information on the sludge regulations can be found in:

ADAS, 2001. The Safe Sludge Matrix (3rd edn.). Wolverhampton: ADAS.

DoE, 1995. Code of practice for agricultural use of sewage sludge, 2nd edn. London: Department of Environment. Available from: <http://www.defra.gov.uk/environment/water/quality/sewage/pdf/sludge-cop.pdf> [Accessed June 2009].

TSO, 1989. The Sludge (Use in Agriculture) Regulations 1989, SI No. 1263. Norwich: The Stationery Office.

How do I use an SGV?

We have published an introduction to SGV, "Using Soil Guideline Values" (Science report SC050021/SGV introduction) that addresses this and other questions. It is available from our web site.

Why is the TDI_{inh} recommended for toluene in the 2009 TOX Report much larger than it was previously in the 2004 report?

The recommended inhalation TDI of $1,400 \mu\text{g kg}^{-1} \text{bw day}^{-1}$ in the 2009 TOX Report is much larger than the older value of $74 \mu\text{g kg}^{-1} \text{bw day}^{-1}$ recommended in the 2004 report. This is due to the recent availability of more extensive occupational data which provide a greater level of insight and understanding of the dose–response of inhaled toluene in humans. Consequently, the uncertainty in the assessment and the uncertainty factors required to have confidence that the derived HCV is tolerable to the wider human population are reduced and the HCV is increased.

Can you provide further guidance regarding selection of a soil-plant availability correction (δ) for calculation of an inorganic soil-to-plant concentration factor?

The values provided in Table 7.2 'Assigning values to δ ' are guidelines. You need to consider in which category each inorganic element sits after a review of the literature.

We do not recommend the use of the PRISM model without a review of the available literature in order to carefully consider parameters for the sub-model. PRISM is a conservative generic model and in most cases a literature value, if based on good data, would be preferred.

Why have you changed the default soil organic matter (SOM) content in the CLEA software (versions 1.04 to 1.06) compared to early versions such as CLEA UK?

We have changed the default value for SOM that is used within the CLEA software (and in the derivation of Soil Guideline Values) from a SOM content of 2.5% to a SOM content of 6%. This is representative of an average value for sandy loam soil which is the default soil type used in the derivation of Soil Guideline Values.

Do the new Health Criteria Values (HCV) and Soil Guideline Values (SGV) represent the trigger for an "unacceptable intake"?

No. Health Criteria Values (HCV), and Soil Guideline Values (SGV) are based on minimal risks to health. SGV are a starting point for evaluating the risk to health from soil contamination. They represent trigger values above which there might be a significant possibility of significant harm with the significance linked to the margin of exceedance, the duration and frequency of exposure and other site-specific factors that the enforcing authority may wish to take into account.

Why does the framework guidance and CLEA software not use probabilistic modelling when it is increasingly being recommended for managing uncertainty?

The original CLEA model introduced a partially probabilistic or stochastic modelling approach for regulatory risk assessment in the UK. However, we have taken the view, and also listened to the views of others, that such an approach made deriving generic assessment criteria for screening contaminated sites too complex.

A probabilistic or stochastic approach has a number of advantages, such as the ability to analyse the shape and distribution of uncertainty for a wide range of parameters. But, the primary purpose of the CLEA model was to derive Soil Guideline Values (SGV) and this did not make full use of these advantages.

We still support the appropriate use of probabilistic or stochastic modelling as part of a detailed quantitative risk assessment. This is consistent with the view taken by experts in other countries, including the United States Environmental Protection Agency.

Why have you derived the K_{oc} for elemental mercury when it is an inorganic compound?

Elemental mercury has had to be treated as an organic chemical for the purpose of deriving Soil Guideline Values (SGV) using the CLEA software (version 1.06 and earlier). This is because the Johnson and Ettinger model (which models vapour intrusion into the building) was developed for organic chemicals. With the exception of organo-metallic compounds, the vapour pathway is rarely, if ever, needed in the assessment of risks from soil contamination with non-organic substances under ambient conditions; elemental mercury has been the exception.

When developing the SGV, we undertook an extensive literature review looking for reported soil-water partition coefficient (K_d) and organic carbon-water coefficient (K_{oc}) values for elemental mercury, with little success. Unfortunately, many of the property estimation methods available are suitable only for hydrocarbons. The source and derivation of the chemical properties used in the derivation of the SGV for elemental mercury, including the K_{oc} , are described in our Science report SC050021 / Technical Review Mercury Supplementary information for the derivation of SGV for mercury, which is available on this website.

In the CLEA software (version 1.06 and earlier), the K_{oc} value used in the derivation of the SGV has been included in the database. As for true organic chemicals, the K_d value for elemental mercury is calculated from K_{oc} and the fraction of organic carbon in soil. The assumption is made that K_d will vary linearly with changes in soil organic matter content (that is, it behaves as an organic chemical). Whilst there is no specific underlying evidence to support this assumption, there is evidence that elemental mercury has an organic character (for example, its ready formation of covalent bonds and its preferential binding to organic matter in soil).

We consider that the approach taken has made the best use of the available information to provide guidance to practitioners on assessing the risks from elemental mercury. Nonetheless, uncertainties are introduced by the necessary use of approaches designed for other types of chemicals.

Why does the CLEA software generate different answers in forwards and backwards mode and which one is correct?

The CLEA software (version 1.06 and earlier) has two modes. The most commonly used is goalseek mode which generates assessment criteria using the Microsoft Excel goalseek function and is accessed from the Results worksheet. The second mode, called ratio mode, is for user entered soil concentrations, typically representative measured values from the site under investigation. Ratio mode can be switched on from the Basic Settings worksheet.

Assessment criteria consistent with our framework reports are generated using the goalseek mode. Although it is possible to use ratio mode to find the soil concentration that equals an ADE / HCV ratio of one by manual trial and error, this will not always be consistent with the goalseek mode because of the different way in which background exposure is handled. This is discussed in both Environment Agency reports SR3 (Updated technical background to the CLEA model) and SR4 (CLEA Software (Version 1.05) Handbook) but a further explanation is given below.

For threshold contaminants the average background exposure (Mean Daily Intake, MDI) from non-soil sources (predominantly, ambient air, drinking water and food products) is taken into account in the derivation of assessment criteria to determine the proportion of the TDI that may be allocated to exposure from soil. The underlying principle is that the MDI is subtracted by the CLEA software from the TDI to give the Tolerable Daily Soil Intake (TDSI) and it is the TDSI that is compared with estimated exposures from soil to derive the SGV. However, where background exposure from non-soil sources is more than half of the TDI, the TDSI should be no greater than 50 per cent of the TDI, in order to avoid disproportionately targeting exposures from soil.

In order to implement this approach in the CLEA software, background exposure via oral and inhalation pathways is not allowed to be greater than the corresponding soil exposure. When calculating individual oral or inhalation assessment criteria, which are estimated by comparing soil exposure by the relevant route with an oral or inhalation TDSI, this means that soil exposure will always contribute a minimum of 50 per cent of the TDI and a minimum of 50 per cent of total exposure at a soil concentration equal to the relevant oral or inhalation assessment criterion.

However, this will not be the case when deriving a combined assessment criterion to take into account systemic toxicity, where there are multiple routes of exposure and both an oral and inhalation HCV. This is because there is no combined TDI and therefore it is not possible to calculate a combined TDSI, nor to ensure that soil contributes a minimum of 50 per cent compared with it. By capping background exposure via oral and inhalation pathways to be no greater than the corresponding soil exposure, the software continues to ensure that the calculations do not disproportionately target exposure from soils. In the combined assessment criterion, background exposure will always be less than 50 per cent of the individual oral and inhalation TDSI but may be capped at a lower level than would be the case when calculating individual oral and inhalation assessment criteria.

For example, consider the SGV for ethylbenzene for the allotment land-use. Ethylbenzene has oral and inhalation TDI of 100 and 220 $\mu\text{g kg}^{-1} \text{ bw day}^{-1}$ respectively, and oral and inhalation MDI of 5 and 130 $\mu\text{g day}^{-1}$ respectively. The Soil Guideline Value (which is the combined assessment criterion) is 90 $\text{mg kg}^{-1} \text{ DW}$. Total exposure is dominated by the oral and dermal routes. Background exposure from non-soil sources has been limited by the software to around 0.4 per cent (0.3 per cent

from oral background exposure and 0.1 per cent from inhalation background exposure).

In this case, the individual oral and inhalation assessment criteria are 91 and 240 000 mg kg⁻¹ DW respectively. For the oral assessment criterion, the oral background exposure contributes 0.3 per cent, the same as for the Soil Guideline Value, and reflecting the dominance of oral and dermal exposure in the combined exposure assessment. However, for the inhalation assessment criterion, the inhalation background contributes a higher amount to total exposure of around three per cent. In deriving the Soil Guideline Value, the CLEA software has capped inhalation background exposure to the level of soil exposure via the inhalation route. This reflects the much lower contribution that inhalation exposure makes to total exposure when considering the combined assessment criterion. If the software did not cap background exposure in this way, the contribution to total exposure from inhalation background at the combined assessment criterion (still 90 mg kg⁻¹ DW) would be around eight per cent, which would be disproportional to the contribution that inhalation soil exposure makes to total exposure of 0.1 per cent.

What approach should be adopted to assess sites contaminated with substances for which HCV and SGV will not be published?

We have published a framework approach that describes how an assessor can consider the risks to human health from land contamination. We consider that the principles contained within this approach can be used to derive soil assessment criteria for a wide range of different chemicals and situations. A local authority can use the approach we have described in our revised guidance as a starting point for considering the risks for substances where there are no relevant substance specific reports. Assessors will still need to be satisfied that they have carried out a scientific and technical assessment of the risks using "relevant, appropriate, authoritative and scientifically based guidance".

Do I have to use SGV and supporting guidance?

No. You can use alternative technical guidance or assessment criteria produced by another organisation provided that you are satisfied they meet the requirements of the legislation you are working under.

What is the approach to lead (Pb)?

Previously, the now withdrawn Report SGV10 (published in 2002) used a bespoke model for deriving an SGV for Pb based on a relationship between exposure and blood Pb concentration. We have considered using an approach based on intake that would allow use of the CLEA software.

Recently, the European Food Safety Authority published an opinion on the toxicology of Pb, which significantly reduced the level of exposure at which experts considered a measurable reduction in development neurotoxicity in children might occur. We are currently considering this further.

What is the approach to asbestos?

We recognise that asbestos is an important contaminant but it is not consistent with the standard CLEA methodology. We are working with the Construction Industry Research and Information Association (CIRIA) to develop further guidance in 2011 / 2012.